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Description

Flexible Parallel Flow Burner with a Swirl Chamber

The invention relates to an externally mixing burner having a burner head, at least one combustion gas tube and at least one oxygen-containing gas tube, whereby the burner head has outlet openings out of the combustion gas tube and out of the oxygen-containing gas tube. Furthermore, the invention also relates to a method for operating an externally mixing burner having at least one combustion gas tube and at least one oxygen-containing gas tube through which the combustion gas and/or oxygen-containing gas flow to the burner head.

Externally mixing burners are used for various applications. For example, a plurality of differently designed burners are used for heating and melting metals or glass. Discovering a burner suitable for all phases of the melting process and for different load cases of the furnace is a challenge here.

Therefore, the object of the present invention is to develop a burner that is advantageously useable for a plurality of applications and for each phase of an application.

The object as formulated is achieved in that gas inlet lines are provided for combustion gas and for oxygen-containing gas, each line being connected to a source for combustion gas and/or for oxygen-containing gas and at least one of these gas inlet lines opening eccentrically into a swirl chamber which is mounted between the gas inlet line and the combustion gas tube and/or between the gas inlet line and the oxygen-containing gas tube.

At least one of the gas inlet lines is preferably split into two lines upstream of the swirl chamber, one of these lines openings eccentrically into the swirl chamber and the other of these lines opening directly into the combustion gas tube and/or into the oxygen-containing gas tube.

Valves are especially preferably provided in the gas inlet lines, these valves being provided in particular in the part of the gas inlet lines where at least one gas inlet line is already divided into two lines and a control unit or regulating unit is available, controlling or regulating the degrees of opening of the valves so that the shape of the flame of the burner is adjustable.

The valves are expediently designed as solenoid valves, which allow a stepwise variable adjustment of the shape of the flame. When demands are higher, the solenoid valves may be replaced partially or entirely by regulating valves which allow a continuously variable adjustment of the shape of the flame.

The swirl chamber preferably has a circular cross-section in a section perpendicular to the longitudinal axis of the combustion gas tube. The gas inlet line especially preferably opens tangentially into the swirl chamber. Due to each of these embodiments, the friction for the swirl flow may be reduced and minimized together.

Referring to the process, this object is achieved in that the combustion gas and/or the oxygen-containing gas is introduced eccentrically into a swirl chamber, where a swirl flow is impressed upon the combustion gas and/or the oxygen-containing gas and the combustion gas and/or the oxygen-containing gas is supplied to the combustion gas tube and/or the oxygen-containing gas tube after leaving the swirl chamber.

The quantities of combustion gas and oxygen-containing gas supplied per unit of time to the burner through the swirl chamber and without the swirl chamber are preferably controlled or regulated, whereby the combustion gas and the oxygen-containing gas are sent through valves whose degree of opening is controlled or regulated so that the burner produces a flame having a desired shape which is adjustable by the control or regulating unit.

For example, in firing industrial furnaces and for melting metals or glass, fuel-oxygen burners are frequently used. When burning fuel with air, the nitrogen present as the main constituent in air acts essentially as a ballast gas. To reduce the volume of exhaust gas, there has been a trend toward operating these burners with an oxygen-containing gas as the oxidizing agent, the oxygen

content of this gas being elevated in comparison with the oxygen content of air. This procedure has the advantage that, due to the lower nitrogen content, the flame temperature is increased and the thermal content of the exhaust gas is reduced, thus making it possible to achieve a higher thermal efficiency and advantageously preventing the formation of nitrogen oxides.

For this invention, air is a suitable oxidizing agent as is oxygen-containing gas having an elevated oxygen content in comparison with the oxygen content of air. The advantage of using air is its universal availability at no cost. The advantages of the higher oxygen content have already been explained.

Air is easily used as the oxygen-containing gas. It is available ubiquitously at no cost.

According to another embodiment of the invention, oxygen-enriched air is used as the oxygen-containing gas. This offers the advantage that it is still inexpensive but already shows some of the advantages of using oxygen for combustion, including the reduced nitrogen content in comparison with air and the higher combustion temperature that can be achieved.

According to a preferred embodiment of this invention, a gas having an oxygen content greater than the oxygen content of air, in particular an oxygen content greater than 30 vol%, is used as the oxygen-containing gas. The advantages in terms of combustion from using oxygen in the oxidizing agent as just described are more pronounced in this embodiment.

According to an especially preferred embodiment of the invention, a gas having an oxygen content greater than 70 vol%, in particular greater than 99.5 vol%, is used as the oxygen-containing gas. In this embodiment, the advantages of oxygen are maximally manifested, but the cost of the oxidizing agent also increases, so that each application should be considered in order to determine which oxygen content is technically desirable or necessary and economically feasible.

A swirl flow is preferably impressed upon the combustion gas flow. The advantage here is that there is good mixing of the fuel with the oxygen with a slightly shortened flame.

According to another advantageous embodiment of the invention, a swirl flow is impressed upon the flow of oxygen-containing gas. This is advantageous because here again the flame is somewhat shortened and the burner can be manufactured more readily with a somewhat simpler design.

According to an especially preferred embodiment of the invention, co-rotational swirl flows are impressed upon the combustion gas flow and the flow of oxygen-containing gas. The advantage here is that the flame is very short and low.

According to another embodiment of the invention, opposing swirl flows are impressed upon the combustion gas stream and the stream of oxygen-containing gas. This is recommended for the case when an extremely short, bushy flame is needed.

A substantial advantage of the invention consists of the fact that the change of the length of the flame can be varied continuously (without varying the quantity of fuel during operation). No changes in the burner (e.g., nozzle replacement) need be made. Thus the instantaneous flame length can be reduced to one-third of its maximum length.

This invention is especially suitable for processes in which solid material is melted to form liquid material, because the melting materials undergo changes in shape and the flame shape can be adjusted to this change.

Another significant advantage of the invention is that the change in the length of the flame takes place continuously and that during operation of the burner, impressing of swirl flow may be begun and stopped again without having to stop the burner and without requiring any design changes such as a replacement of the traditional swirl disk. The change of the shape of the flame

takes place via the change in at least one of the two gas flows by only setting the degree of opening of the described valves, which, in turn, is accomplished via the control unit or regulating unit according to the invention.

The inventive externally mixing burner is suitable in particular for melting metals or glass.

Hereinafter, the invention and additional details of the invention are explained in greater detail with reference to an exemplary embodiment that is illustrated in the figures. The figures show in

Figure 1 an inventive burner

Figure 2 a section along line A-A

Figure 3 a section along line B-B

In particular, the figures show a burner 1 having a burner head 2, tube 4 for an oxygen-containing gas and a combustion gas tube 3 (not shown). The two tubes are arranged concentrically in such a way that the combustion gas tube 3 is mounted inside the tube 4. A burner 1 having this design is also known as a parallel flow burner. Natural gas is used as the combustion gas, for example.

Exemplary operation of the burner 1, in which the two gas flows are co-rotationally swirled, is as follows: when the valve 10 is opened, natural gas flows from the gas inlet line 6 through the line 6a into the swirl chamber 8, where a swirl flow is impressed upon the natural gas flow. In so doing, the valve 11 is closed.

Oxygen-enriched air is sent through the gas line 7 and the line 7a into the swirl chamber 9, where a co-rotational swirl flow in the same direction as the natural gas flow is impressed upon this gas flow. In so doing, the valve 12 is opened and the valve 13 is closed.

The flow of oxygen-enriched air leaves the swirl chamber and is introduced into the tube 4. The natural gas flow is introduced into the combustion gas tube 3.

The two gas flows become mixed at the burner head 2, resulting in a characteristic flame. The shape of the resulting flame depends directly on the setting of the valves 10, 11, 12 and 13.

For example, the flame becomes longer when the combustion gas flow is added with the valve 11 opened and the valve 10 closed, i.e., no swirl flow is impressed upon the natural gas flow. The flame becomes longer in comparison with the just described flame, in which a swirl flow is impressed upon both gas flows.

Likewise, it is possible for only the natural gas flow to have the swirl flow and for the flow of oxygen-containing gas to be supplied without the swirl flow through the line 7b and the opened valve 13 to the tube 4.

Due to the design of the valves 10, 11, 12 and/or 13 as regulating valves, intermediate settings, i.e., adjustable degrees of opening of these valves are made possible. Therefore, the shape of the flame is continuously adjustable. The shape of the flame is varied—without problem during operation of the burner 1—by means of the control unit or regulating unit for the valves 10, 11, 12, 13.

The quantities of combustion gas and oxygen-containing gas supplied must be taken as boundary conditions for the shape of the flame. Once the supplied amounts have been selected, they remain constant during operation of the burner. A short bushy and broad flame to a long narrow flame is simply produced through the choice of the valve settings for the valves 10, 11, 12, 13.